Making a Product Development Team Flexible:

The Role of Strictness of Review Process

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Abstract

During the course of Product Development (PD), a product is continuously evaluated at each stage. The review process adopted for evaluating the progress can vary in terms of ‘strictness'. We explored how this strictness affects a team's ability to adapt (Team Flexibility) and perform (Efficiency) in a dynamic environment. To conduct this study, we adopted a cross-sectional research design. We surveyed 120 PD teams using the survey instrument developed for this study. Our result shows that a high degree of strictness impairs the efficiency of a team regardless of their size. The above finding implies a trade-off between flexibility and efficiency of teams (both small and large) while operating in a dynamic environment.

Keywords: Team Flexibility, Product Development, Review Process, Strictness

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Review processes used by teams are an integral part of any Product Development (PD) activity. They help to control and regulate the activity. Popular examples include quality process and the ‘gates’ in a ‘Stage-gate’ model of PD. Understanding review processes and how they facilitate (or restrict) a team’s flexibility (ability to adapt to and absorb changes), both directly and indirectly, is a relevant topic for organizations to understand and researchers to address.

Developing a new product in a dynamic environment is a challenging task for an organization. On the one hand, they have to dedicate both time and resource to manage unforeseen changes and uncertainties, and on the other, they have to ensure that there is no or minimum escalation in time and costs. To succeed in such demanding conditions, organizations have to employ processes that facilitate achievement of both flexibility and efficiency. In this study, we try to understand how one such process (review process) employed by PD teams impacts its flexibility and efficiency. Specifically, we aim to understand how the ‘degree of strictness’ of a review process impacts team efficiency and how this relationship is influenced by size of the team.

The literature in this area is very sparse. In fact the literature related to understanding team flexibility itself is in nascent stages thus meriting more attention from researchers. The research work by Sethi and Iqbal (2008) comes close to our topic of interest. In their paper, Sethi and Iqbal (2008) examine the effect of Stage-gate controls on project flexibility. However, they don’t address the topic of team flexibility. Our interest is oriented towards ‘team flexibility’ and on ‘review processes’, not just stage-gate process.

In an effort towards achieving our objective, we first explore literature related to – (1) importance of teams and team flexibility in product development context, (2) review processes, (3) control perspective of review process and (4) how review processes impact team flexibility and efficiency. We then propose the hypotheses related to relationship between degree of strictness and team efficiency and moderating role of team size. Finally, in the last section, we validate the hypotheses. The results show that degree of strictness does influence efficiency positively irrespective of team size. Based on these results, we try to draw inferences for teams and organizations involved in product development activity.

Product Development Teams

Product Development (PD) is a process of transforming an idea to a product. A PD effort includes a wide range of activities- It begins with the identification of an opportunity (idea generation), transforming this idea into a product (design and development) and finally, ends with commercialization of the product (production, sale, and delivery of a product) (Ulrich & Eppinger, 2004).

One of the most popular forms of organizing a PD activity is by employing a cross-functional team (Griffin, 1997) i.e. a team formed by people from different specializations. These teams employ a decentralized structure, with low degree of formalization and are usually self-managed. The cross-functional teams form the core of PD effort and are critical to the success of PD activity (Smith, 2007).

A PD team is a type of ‘Project team’. A Project team is usually constituted by organizations to perform tasks that are non-repetitive in nature (tasks can be either incremental or an entirely new one) and deliver a one-time output in a limited time-frame. These teams employ decentralized and flatter structure to carry out their tasks. Team membership is tenure-based with

the tenure depending on duration of project. Team composition is usually cross-functional. The above characteristics help these teams to be adaptable to changes and effectively manage situations of uncertainty (Cohen & Bailey, 1997).

Need For Flexibility

There is an increasing need for organizations and teams to be flexible. Globalization, rapid technology diffusion, shorter product life cycles have contributed to volatility in the business environment. With environment becoming progressively dynamic, organizations require methods to deal with emerging situations. It is in this context that the term 'flexibility' becomes a relevant criterion. Organizations have to continuously adjust to retain their competitive advantage and counter the effect of a changing environment (Das & Elango, 1995). Organization flexibility is an important parameter in evaluating an organization's performance in such environments (Evans, 1991). The competitive pressures at organization level translate into changes and uncertainties at team level. A successful team has to demonstrate flexibility to handle these uncertainties and respond to changes effectively. Thus, flexibility at the level of teams and organizations has become necessary to survive and thrive in a dynamic environment. In this paper, we restrict ourselves to understanding flexibility at team level.

Defining PD Team Flexibility

The construct of flexibility has been a source of ambiguity (Golden & Powell, 2000). Researchers have found it to be a 'hard-to-capture' construct because of its polymorphous and multi-dimensional nature (Sethi & Sethi, 1990). In this paper, we refer to the recent framework developed by Golden and Powell (2000) for defining and understanding the construct of flexibility. The framework views flexibility as a capacity of an entity to deal with environmental

changes and uncertainties by suitably adapting to it. Thus, flexibility is defined as a '*capacity to adapt*'. This general definition derives its specific meaning when placed in a specific context. For example, a manufacturing unit or a team is flexible if it has the capacity to adapt to environmental change and uncertainties. The framework by Golden and Powell (2000) also identifies four dimensions related to flexibility. The 'dimensions' represent the area in which flexibility can be achieved. They are: Temporal, Range, Intention and Focus. Temporal represents the time taken by entity to respond, Range represents the ability to respond to changes both foreseen and unforeseen, Intention tries to capture whether entity is offensive or defensive to change and finally, focus represents the resource (internal/ external) with which flexibility is achieved.

Based on the above conceptualization, we define PD team flexibility as '*a capacity of a PD team to adapt effectively to foreseen and unforeseen changes, reactively or proactively through internal and external means*'.

Review Process

During a PD process, the progress of the product is continuously evaluated at each stage. The review points are the instances during the development process wherein information regarding the project is reviewed and decisions regarding proceeding to next stage (or to halt the development activity until more information is made available) are taken (Schmidt, Sarangee, & Montoya, 2009; Sethi & Iqbal, 2008).

Majority of the process used for product development have review points built into them. One such popular PD process is the Stage-Gate process (Trott, 2008). A stage-gate model has two components: an activity phase called 'stage' and a review phase called 'gate'. The activities starting from idea generation to commercialization are grouped into what are known as 'stages'.

A project typically has around 4-5 stages. Decision points called ‘gates’ are positioned between two stages for evaluating the outcome of the respective stage with the set criteria. These gates serve as quality control mechanisms. At each gate decision is taken regarding proceeding, redoing or killing the product. This kind of model helps in progressive evaluation of the product and also reduces the risk of ending up with a wrong product after a lengthy development cycle (Trott, 2008).

Review Process can be better understood from a ‘management control systems’ perspective. A review process functions both as a process control and output control mechanism. As a process control mechanism, a review procedure would provide a development team with information about the steps required to achieve the specific gate objectives. As an output control mechanism, a review process specifies the criteria for evaluating the progress made in each phase which might vary in terms of strictness, uniformity and frequency from one context to another (Sethi & Iqbal, 2008). These review criteria are usually enforced formally to ensure the necessary discipline while achieving the set performance targets.

Strictness of Review

The ‘Strictness of review’ refers to the degree to which the review criteria are formally established, followed and strictly enforced by organizations (Sethi & Iqbal, 2008**).** It has influence on flexibility and efficiency of teams.

The strictness of review impacts the flexibility of a PD team negatively. As a process control mechanism, the review process establishes a sense of stability during PD and thus constrains a PD team’s ability to experiment. The challenge to flexibility becomes even more acute when the review criteria are enforced strictly. In an effort to meet the strict criteria, teams

tend to freeze the definition of their projects early in their development cycle. This kind of early decisions related to project definition acts as a constraint in accommodating changes at a later stage in the development cycle when teams discover new aspects related to product. In other words, strict review criteria restricts a teams' ability to deviate from project parameters and makes them pre-disposed to meeting the standards rather than experimenting and accommodating new ideas into the product (Sethi & Iqbal, 2008). Therefore, opting for a low degree of strictness contributes positively to the team flexibility i.e. a low degree of strictness would facilitate PD teams to deal with emerging situations effectively.

Effect of strictness on the efficiency of teams

In the absence of any studies connecting strictness of review and efficiency, we have to look at an alternate concept which is comparable with 'strictness of review'. One good fit is the concept of formalization especially 'high degree of formalization'. A strict review procedure can be construed as a process with a high degree of formalization. A high degree of formalization is associated with bureaucratic organizations. These organizations are mechanistic in nature, low on flexibility and are aimed at delivering high efficiency (Burns & Stalker, 1961). Thus, a high degree of formalization is viewed as a mechanism to improve efficiency. From the above insights, we can deduce that high degree of strictness in review process impacts team efficiency negatively. Hence we propose the following hypothesis:

Hypothesis 1: Strictness of Review increases Team Efficiency

Effect of team size

In an effort to better understand the relationship between strictness and efficiency, we wanted to investigate whether the size of team has any influence on this relationship. Team size has been regarded as an important structural variable that influences team performance. Since

team performance also includes the component of team efficiency (Hoegl & Gemuenden, 2001), there are possibilities that hypothesized relationship between Strictness of review and Team Efficiency is influenced by size of the team.

To understand the nature of influence of team size, we refer to the Steiner's theory (Steiner, 1972) regarding productivity loss. According to him, a large team suffers from higher process loss which in-turn results in lowering productivity. Process loss includes two components: motivation loss and co-ordination loss. Steiner argued that a team member working in a large team is likely to experience a higher difficulty in co-coordination and is also likely to experience a low level of motivation towards his work resulting in 'losses'. These process losses result in drop in team performance. We can infer from Steiner's theory that team size is likely to moderate the relationship between strictness and performance with smaller teams performing better compared to large teams. Hence, we propose the hypothesis:

Hypothesis 2: Team size moderates the relationship between Strictness of Review and Team Efficiency

The relationship between Strictness of Review, Team Efficiency and Team size has been captured in the conceptual model presented below. Strictness of Review is the independent variable and Team Efficiency is the dependent variable. This relationship is moderated by Team Size.

Insert Figure 1 about here

Questionnaire development

The research work presented in this paper is actually a portion of a study related to understanding team flexibility. The study has dealt with many aspects of team processes like review processes, decision making, autonomy, formalization and product related aspects like newness, complexity and interdependency. In this paper, we have restricted ourselves to findings related to effect of review procedure strictness on the efficiency of small and large teams.

We developed a survey instrument exclusively to conduct the study on team flexibility. The items used for measuring the variables were sourced from literature. The final questionnaire consisted of 48 questions, inclusive of all four sections. The questionnaire was designed keeping in mind the flow and continuity between sections. The questionnaire had four parts. Part A captured the respondents' professional experience, team and organization details. Part B contained items related to practices followed by the team and Part C consisted of items related to complexity level of the product being developed by the team. The final section (Part D) captured the performance of team. A five point Likert scale was employed for capturing the responses.

Prior to the development of final version, several draft versions of questionnaire were prepared. The draft versions underwent two rounds of pre-testing. The first round of pre-testing was done internally followed by a second round of testing from two chosen experts. The experts were identified based on academic qualification (i.e. should be a doctorate) and industrial experience (atleast 10 years) in the product development field. The questionnaire was evaluated both from academic and industry perspective. A total of 10 changes were made based on the expert's recommendation for improving the clarity, flow and structure. Further refinements to the questionnaire were carried out after the pilot study.

Data and Sample for the Study

For this study, we adopted a cross-sectional research design. We conducted a survey of 120 PD teams using an instrument exclusively developed for this study. Convenience sampling strategy was adopted for this study. The unit of analysis was teams. We collected data from teams in public and private sector - Public sector was represented by teams in Defence based R&D companies, and private sector by software PD organizations. Companies with more than 10 years of PD experience and employing more than 1000 employees were preferred. Contact was made with respective HR heads or through known individuals in top management. The teams that participated in this study were identified by the HR heads or PD heads. Target respondents were Team Leaders and/or Managers involved in Design and Development phase of the PD. A total of 120 responses were collected, out of which 108 were subjected for analysis. Responses were captured using a five point Likert scale (1-Strongly Disagree to 5-Strongly Agree). The final questionnaire consisted of 48 items. Cronbach alpha was used as a measure of Reliability. The derived factors had an alpha value of greater than 0.6. Content validity was also ascertained.

Sample Description

A total of 120 responses were collected for the study, out of which 8 were not usable. Of these 112 responses, four were excluded based on the exclusion criteria. Thus, a total of 108 responses were available for analysis.

Respondents' profile

The respondents included Team Leaders (TL), Project Managers (PM), Senior Managers (SM) and Others (O). Team Leaders (TL) formed the majority of the respondents (50%), followed by Project Managers (37%).Overall the sample had fairly equal representation from Team Leaders and Managers(PM and SM). Data was also collected from recommended experts

and individuals with rich experience in PD. These responses have been tabulated under the heading ‘Others’.

Insert Figure 2 about here

Industry profile

Figure 2 presents responses categorized based on industry type – Software, Electronics and other industries. Of the total 108 respondents, 51% (55 out of 108) and 47 % (51 out of 108) of the respondents belonged to Software and Electronics industry respectively.

Insert Figure 3 about here

Team Profile

Team size refers to number of individuals directly reporting to the respondent. For analysis, teams were dichotomized into small and large teams. Large teams had 10 or more team members. In this sample, the results show that proportion of small teams (57%) is greater than large teams (43%).

Insert Figure 4 about here

Construct Measurement

We used three constructs for this study- Strictness of review, Team Efficiency and Team Size. In this section, we present details related to operationalization of these constructs and their reliability scores.

The construct ‘*Strictness of review’* was measured with three variables – (1) formally established procedure, (2) degree of usage, and (3) adherence to procedure. These measures were

adopted from Sethi and Iqbal (2008). The construct exhibited good reliability (Cronbach alpha of 0.621).

The construct '*Team Efficiency*' was measured with two variables – impact of late changes on (1) cost and (2) schedule of the project. These measures were adopted from Hoegl and Gemuenden (2001). The construct exhibited high reliability (Cronbach alpha of 0.826).

'*Team Size*' refers to the number of individual working for a PD team. It was measured as the number of individuals directly reporting to the respondent (respondents were team leads/ managers). This variable was later dichotomized into small and large teams to serve as moderator variable. A team size greater than 10 was considered as large team.

For the sake of convenience, the construct and items are listed in the below table

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Insert Table A1 about here

Since the results presented in this paper are a part of major study, the items of these constructs were subjected to factor analysis along with other constructs to confirm the factor structure. The results of the factor analysis related to the constructs of Strictness of Review and Team Efficiency are presented in Table A2 and A3 respectively.

Insert Table A2 and Table A3 about here

Hypothesis Testing

To test the hypotheses, we performed a multiple linear regression analysis of Strictness of Review on Team Efficiency (Team Efficiency-dependent variable, Strictness of Review - independent variable, Team Size – moderator variable). We used factor scores for regression.

For conducting factor analysis, we adopted Principal Factoring technique as it doesn't require us to assume the distribution of responses. The number of factors to be extracted was based on Kaiser Criterion. After extraction, we employed the technique of VARIMAX rotation to produce uncorrelated and interpretable factors. The resulting factor structure was similar to the constructs used for the study (Refer Appendix).

The regression model proved to be significant (F = 7.464, p-value = 0.000), with an adjusted R-square value of 0.161. Refer Table A4 for results. The effect of RPS on team efficiency was significant (p-value = 0.019) and positive in nature. Thus, there was no evidence to reject hypothesis 1 (i.e. strictness of review process positively impacts Team Efficiency). The interaction term (TS X RPS) was not significant (p-value = 0.323) suggesting absence of moderation effect. Accordingly, Hypothesis 2 was rejected.

Insert Table A4 about here

Results and Discussion

Effect of Strictness of Review on Efficiency

The hypothesis related to relationship between Strictness and Efficiency (H1) is accepted confirming that a high degree of strictness impairs the flexibility of teams. This result is in line with the literature related to 'high degree of formalization'. A high degree of formalization has been viewed by researchers as a means to promote efficiency at the cost of flexibility. This is reflected in our finding also suggesting a possible trade-off between flexibility (achieved through implementation of less strict review procedure) and efficiency of teams. In terms of practical implication, organizations operating in a dynamic environment have to be aware of the negative consequences of lowering the strictness of review procedure in the interest of promoting PD

team flexibility. Perhaps, one way of balancing the trade-off is by mapping stages where flexibility is essential and executing the remaining stages of product development with a strict review procedure to achieve the desired level of efficiency.

Effect of Team Size

The hypothesis related to team size (H2) is rejected indicating that team size doesn't moderate the relationship between strictness and efficiency. In other words, small and large teams face a similar level of drop in efficiency due to increase of flexibility (achieved by implementing less rigorous review procedure). This finding is counter-intuitive as we expect small teams to exhibit a higher level of performance (and hence more flexibility and more efficiency) compared to large teams. At a broad level, the finding hints that organizations can adopt review techniques (with various level of strictness) during PD without having to be concerned about team size. However, there are possibilities that other team structure related variables (team composition, task design etc) might play a role in influencing this relationship, and which needs to be explored in future studies.

Limitations

Majority of the data for the study has been sourced from three organizations. These companies were all based out of Bengaluru, India. Although we took care to randomly select teams within organization and avoid any bias, it is suggested to include more organizations in the sample for better representation of the population. A better sampling strategy would also be very helpful in generalizing the results. Our study doesn't consider the effect of other team related variables such as team composition, team cohesion, etc. that can possibly influence the nature and magnitude of the relationship between review strictness and efficiency.

Conclusion

In this paper, we explored how a strict review process impacts team flexibility and team efficiency. The study showed that a strict review process would improve team efficiency at the cost of flexibility for both small and large teams. These results suggest that PD organizations need to work towards different models of reviewing progress of product development activity keeping in mind the need for flexibility and efficiency. A less rigorous review process towards the beginning and stricter review procedure towards the end might provide the necessary means to achieve sufficient mix of flexibility and efficiency.

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Appendix A

Table A1

Construct and their measures

No	Construct	Items
1	Strictness of Review Process	1. Criteria for reviewing the progress of Product Development are formally established in your firm. 2. Review criteria must be met before a project is allowed to proceed further. 3. Review results are formally made use of by the team. Source: Sethi, R., & Iqbal, Z. (2008)
2	Team Efficiency	1. Changes that came in late impacted the project costs. 2. Changes that came in late impacted the project schedule. Source : Hoegl & Gemuenden (2001)

Table A2

Results of Factor Analysis for 'Strictness of Review' Factor

Strictness of Review Procedure	Loadings
Criteria for reviewing the progress of Product Development are formally established in your firm.	0.393
Review criteria must be met before a project is allowed to proceed further.	0.555
Review results are formally made use of by the team.	0.816
% variance	10.068
Cronbach alpha	0.621

Table A3

Results of Factor Analysis for 'Team Efficiency' Factor

Efficiency	**Loadings**
Changes that came in late impacted the project costs.	**0.918**
Changes that came in late impacted the project schedule.	**0.766**
% variance	24.621
Cronbach alpha	0.826

Table A4

Results of regression analysis of Team Efficiency (Dependent variable) on Review procedure Strictness and Team Size

Variables	**S. E.**	**Beta**	**t**	**Sig.**
Review Procedure Strictness(RPS)	0.14	0.30	2.39	0.02***
Team size(TS)	0.15	0.15	1.63	0.11
TS X RPS	0.20	0.13	0.99	0.32
Intercept	0.13		-1.32	0.19

(1) *, ** and *** indicate significance at 90 %, 95% and 99% level respectively

(2) Multiple R-square = 0.186, Adjusted R-square = 0.161

(3) Sample size: N = 106

Appendix B

Figure 1. Conceptual model

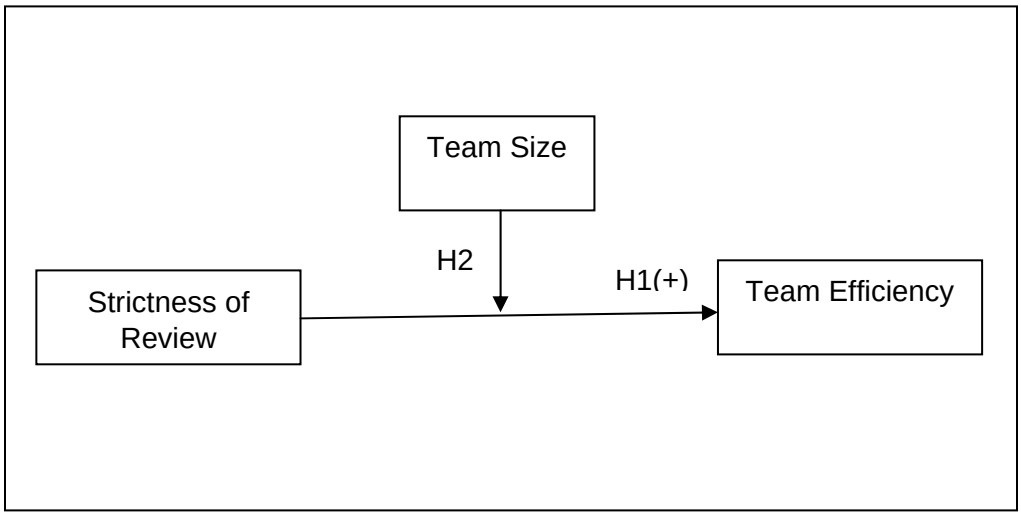

Figure 2. Distribution based on the Designation of the respondents

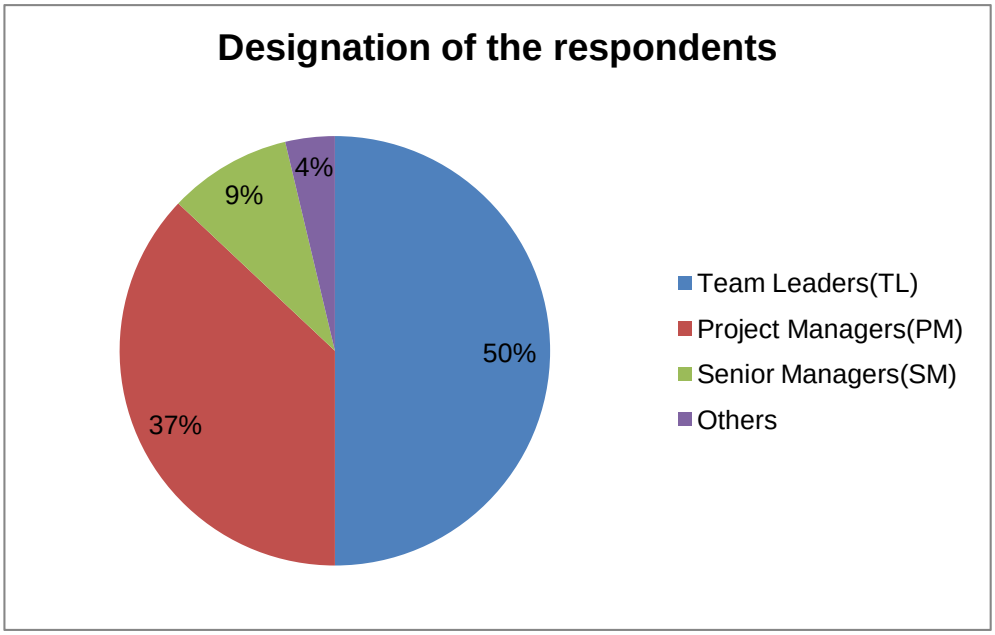

Figure 3. Distribution of teams across industry type

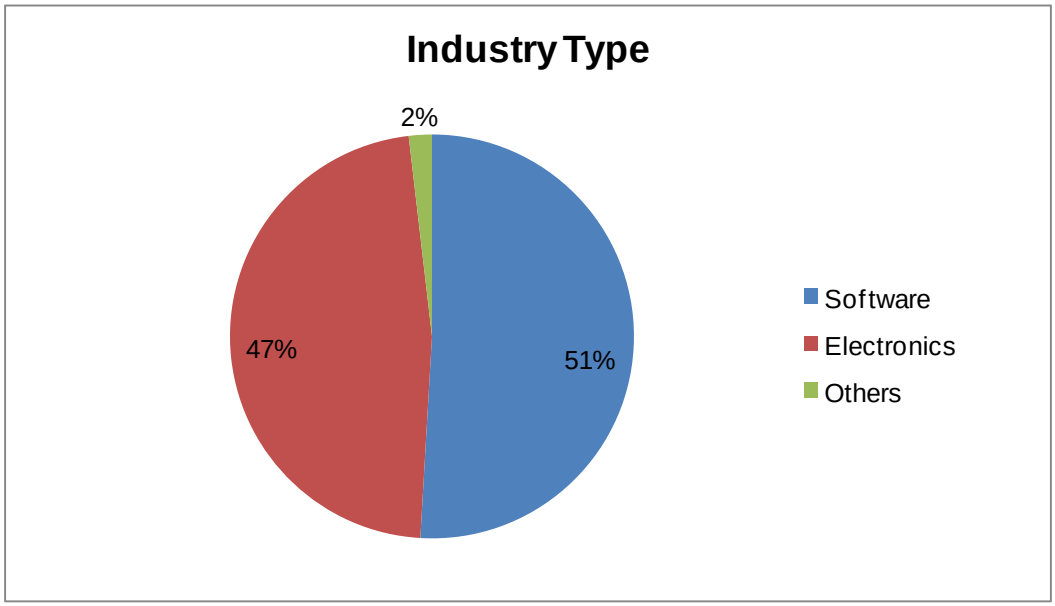

Figure 4. Distribution based on team size